Life History of *Zygogramma disrupta* in Southeast Texas

(Coleoptera: Chrysomelidae)[1]

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The ragweeds (*Ambrosia* spp.: Compositae) are important agricultural and hayfever-inducing weeds throughout much of North America (NAS 1968, Wodehouse 1971) and Eurasia (Kovalev and Runeva 1970, Kovalev 1971). The most abundant and widespread species include common ragweed (*A. artemisiifolia* L.), western or perennial ragweed (*A. psilostachya* DC.), and giant ragweed (*A. trifida* L.) (Payne 1970). Surveys of the entomofaunas of these and other North American ragweeds have revealed the existence of a diverse assemblage of insects (Hack 1935, Harris and Piper 1970, Piper 1970, Stegmaier 1971, Goeden and Ricker 1974a, 1974b, 1975, 1976a, 1976b, 1976c).

In southeast Texas, *A. psilostachya* is attacked by several species of phytophagous Coleoptera. One such associate is the chrysomelid, *Zygogramma disrupta* (Rogers).

The genus *Zygogramma* Chevrolat contains 14 species in America north of Mexico (Arnett 1968) and 85 Neotropical species (Bechyne 1952). Linell (1896) provided a key to the Nearctic species. Biological information is available for only 2 North American species, the sunflower beetle, *Z. exclamationis* (Fabricius) (Walker 1936), and *Z. suturalis* (Fabricius) (Piper 1975). Rogers (1856) described and illustrated the adult of *Z. disrupta*. The occurrence of this beetle on weeds and willow (*Salix* sp.) during the summer months in Kansas was noted by Douglass (1929). The paucity of information on the biology of *Z. disrupta* prompted the study reported herein.

Materials and Methods

Studies on the life cycle of *Z. disrupta* were conducted in the laboratory and correlated with field observations. The laboratory colony, started from adult beetles collected from *A. psilostachya* growing in or near College Station (Brazos Co.) during 1976 and 1977, were maintained in the laboratory at 24 ± 2°C, 75 ± 5% RH, and a 14L:10D photoperiod. Eggs, larvae, and adults were confined to 10.0

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x 1.5 cm petri dishes provisioned with moistened filter paper and ragweed foliage. Water and food were renewed at 48 hr intervals. Pupae were held in petri dishes containing moist peat moss.

Life History

Zygogramma disrupta has been recorded from Nebraska, south to Mexico, east to Louisiana, and west to Arizona (Rogers 1856, Powell 1932, Wilcox 1975). Based upon descriptions provided by Rogers (1856) and Linell (1896), adults are broadly oval, convex, with the head and pronotum dark brown; each elytron cream-colored, with suture and four narrow discal vittae dark brown; first vitta free, slightly abbreviated basally and apically; second and third sinuous, abbreviated basally and confluent apically; fourth short, confluent with third basally; three submarginal spots apically; fourth short, confluent with third basally; three submarginal spots apically; epipleuron cream-colored with dark brown margin. The lengths of 25 males and 25 females averaged 5.75 ± 0.06 mm and 6.47 ± 0.07 mm, respectively.

Z. disrupta is a bivoltine species in southeast Texas. First generation overwintered adults began emerging during early June at a time when *A. psilostachya* plants were 20-25 cm in height. Peak populations were attained by mid-June. Adults of the second generation emerged in late July with peak populations being found during early August. Both sexes emerged concurrently. Sex ratio was determined by examining 94 beetles which emerged from laboratory-reared first generation pupae. The male:female ratio was 1.0:1.3.

The beetles did little flying, remaining closely associated with the uppermost foliage of the host plant. Rarely were more than three individuals found per plant in nature. The adults fed upon both older and newly developed leaves, often consuming leaf laminae in their entirety except for the midribs and immediately adjacent tissue. Adults feign death and drop from the plant at the slightest disturbance, their coloration blending imperceptibly with the soil and/or litter below. The average life span of laboratory-reared adults was 49.3 ± 8.4 (range 12-83) days for males and 58.4 ± 5.4 (range 10-111) days for females.

The premating period was not determined. Mating occurred most frequently during either the late morning and/or mid- to late afternoon in both the field and laboratory. All matings observed in nature occurred on the upper surfaces of leaves or in leaf axils of the host plant. The act of copulation in *Z. disrupta* was similar to that of *Z. suturalis* (Piper 1975). The male mounted the female from behind by moving directly forward and onto her dorsum. The male positioned himself on the posterior dorsum at a 45° angle with his forelegs resting upon the female's elytra near the second vittae. The middle pair of legs grasped the elytral margins or epipleura near the apex.

The male's hind tarsi flanked the vagina. The tarsal lobes were rubbed across the vaginal area preparatory to aedaegus extrusion and intromission. The female generally was quite passive after the initiation of copulation and often fed while in copula. When a female became restless and started to move about on the plant, copulatory activity was suspended immediately; the male merely rode the female's dorsum until another site was selected. Upon the cessation of female movement, the male resumed copulation. The time spent in copula varied from 15 min to two hr. Repeated matings between the same male and female occurred frequently in the laboratory both before and after oviposition had commenced. However, mating declined steadily in frequency as the female aged. A male was capable of mating with different females and a female accepted different males.

The preoviposition period, from emergence to first deposition of eggs, of 25 females averaged 12 ± 0.8 (range 9-14) days. The oviposition period averaged 37.3 ± 4.7 (range 7-97) days during which time the females laid an average total of 262 ± 43 (range 27-845) eggs. Daily egg production was quite variable. Based only on days when females oviposited, the daily totals ranged from 1 to 40 and averaged 9.3 ± 0.7 eggs.

Oviposition occurred most commonly during the late afternoon or evening. Eggs characteristically were deposited in clusters of 2 to 18 on the undersides of young ragweed leaves. Of 100 clusters examined, 75 contained two to five eggs, with a mean of five eggs/cluster. The eggs overlapped one another and stood out from the leaf at a 45° angle. In the field, first generation eggs were found from mid-June to late July; second generation eggs from mid-August to late September.

The egg is ellipsoidal, yellowish-orange and has an asperate chorion. The mean length and width of 25 eggs were 1.57 ± 0.01 mm and 0.69 ± 0.01 mm, respectively. The incubation period of 300 eggs averaged 6.26 ± 0.03 (range five to seven) days. Eggs in the same cluster usually hatched concurrently.

Recently hatched larvae were pale orange and fed together at the margin of the leaf on which the eggs had been laid. The pale yellow second-, third-, and fourth-stage larvae were less gregarious and distributed themselves among the uppermost foliage. Larvae fed on the upper surfaces of leaves and the resultant damage resembled that produced by adult feeding. When touched or disturbed while feeding, third- and fourth-stage larvae either regurgitated undigested foodstuffs or voided a droplet of fecal material, a behavioral trait also characteristic of *Z. suturalis* larvae (Piper 1975). Confinement of late stage larvae to potted ragweed usually resulted in extensive defoliation and plant death. However, the damaging defoliation levels produced in the laboratory were never observed among field populations of *Z. disrupta* larvae.

The maximum lengths attained by 25 first- to fourth-stage larvae were 2.43 ± 0.02 mm, 3.22 ± 0.06 mm, 4.25 ± 0.07 mm, and 6.00 ± 0.13 mm, respectively. Under laboratory conditions, the stadia of larval development were as follows: first, 5.2 ± 0.1 (range four to seven) days; second, 3.6 ± 0.2 (range two to six) days; third, 4.2 ± 0.2 (range three to eight) days; and fourth, 7.3 ± 0.4 (range six to ten) days.

During the fifth or sixth day of development, a fourth-stage larva ceased feeding, descended to the ground directly beneath the plant, and burrowed five to ten cm into the soil. Having reached a suitable depth, the larva pushed and compacted the surrounding soil, creating an ellipsoidal chamber. After completing the earthen cell, the larva became quiescent and entered the prepupal stage which lasted 6.8 ± 0.6 (range five to nine) days.

Pupation occurred within the chamber. The pupa is pale yellow and the mean length of 25 pupae was 5.87 ± 0.06 mm. The duration of the pupal period averaged 7.8 ± 0.1 (range seven to nine) days. After ecdysis, teneral adults remained underground one to two days before emerging. Upon emergence, adults are pale and are still quite soft. Normal coloration and complete sclerotization were attained within eight to twelve hr. During late September and October, overwintering of adults produced from second generation pupae commenced within the pupal cells. In the laboratory, the time required for a complete life cycle, from egg to adult, was 39 ± 1 (range 28-41) days.

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